Data Reduction Techniques for Real-time Fault Detection and Diagnosis, and Multiple Fault Inference with Imperfect Tests

Qualtech Systems

Technical Abstract
Space travel is fraught with ever changing emergencies and accidents that place human life and expensive one-of-a-kind autonomous systems at risk. Hypothetical collisions with space debris, human and computer errors are just a few examples of such risk. In this effort, we propose space based logistics technologies that can ameliorate and minimize the inherent risks due to space travel. We shall adapt agent based logistics technologies developed by 21st Century Technologies for DARPA's Ultra*Log project that can be exploited for use by autonomous systems and by astronauts on shuttle missions. Multiple fidelity processing is one such technology that will be demonstrated to successfully manage a simulated emergency. Multiple fidelity processing manages the level of specificity involved in reasoning about logistics in order to receive a solution in real time. In this effort we shall demonstrate the utility of automated multiple fidelity planning for space based assets in the context of satellite operations to present real time potential solutions to simulated emergency situations. The ability to manage such situations is necessary to promote NASA's vision of filling space with robotic explorers and making operations closer to home more efficient using ever more intelligent automated planners.

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2007 Phase II
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Information Technologies for System Health Management, Autonomy, and Scientific Exploration

Integrating Prognostics in Automated Contingency Management Strategies for Advanced Aircraft Controls

Impact Technologies, LLC

Technical Abstract
Automated Contingency Management (ACM) is an emerging and game-changing area of engineering and scientific research that integrates prognostics and health management concept and intelligent control. As leaders in this field, Impact Technologies and Georgia Institute of Technology, propose to build off a strong foundation of ACM research performed with NASA and DARPA in the past few years to both mature the applicability of ACM technology for real aerospace components and push the envelop on the capability and breadth of the technology itself. A prognostics-enhanced, three-tiered ACM architecture for critical aerospace systems has been conceptualized and demonstrated in Phase I. The proposed Phase II effort is focusing on utilizing prognostics at the higher levels of the control hierarchy and is introducing novel concepts to address the fault-tolerant control design at the middle level from the areas of model predictive control, system dynamic inversion, intelligent search techniques, and optimization / system identification algorithms for mission adaptation at the high level. Game theoretic notions are exploited to distribute optimally the available control authority between the components. An electromechanical flight actuator and a UAV platform will be utilized as testbeds for performance evaluation. Significant benefits are anticipated to NASA, DoD, and industry.

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